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SELF COOLING MODIFIED ATMOSPHERE PACKAGING FOR A FLORAL GROUPING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. Serial No. 10/202,068, filed July 23, 2002; which is a continuation of U.S. Serial No. 09/908,535, filed July 18, 2001, now U.S. Patent No. 6,460,316, issued October 8, 2002; which is a divisional of U.S. Serial No. 09/366,507, filed August 3, 1999, now U.S. Pat. No. 6,357,207, issued March 19, 2002; the contents of each of which are hereby expressly incorporated herein by reference in their entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable.

BACKGROUND OF THE INVENTION

[0003] 1. Field of the invention:

[0004] The present invention relates generally to methods for packaging floral groupings, and more particularly, but not by way of limitation, to methods for packaging floral groupings in self cooled modified atmospheres.

[0005] 2. Brief Description of the Art

[0006] Methods of packaging fruits and vegetables in controlled or modified atmospheres have been used commercially for many years. Controlled or modified atmospheres contain modified concentrations of oxygen and carbon dioxide, and have been shown to be more beneficial than similar storage of the produce in air. The same principle of altering the atmosphere in a storage container with respect to oxygen (O_2) and carbon dioxide (CO_2) levels is used in both controlled atmosphere storage and modified atmosphere storage. The two differ in that controlled atmosphere storage involves continuous monitoring and controlling of the levels of the two gases, while modified atmosphere storage does not involve control of the gas concentrations after initial packaging of the storage item.

[0007] Benefits of self cooled controlled atmosphere/modified atmosphere storage include slow ripening of fruits, retardation of the spread of diseases, inhibition of toughening, and undesirable yellowing, etc. Many fruits have been commercially stored in controlled or modified atmospheres and include apples, cherries, strawberries, figs, kiwi fruit, nectarines, peaches, pears, avocados, tomatoes, and bananas. Many vegetables have been commercially stored in controlled or modified atmospheres and include asparagus, beets, broccoli, lettuce, potatoes, cabbage, cantaloupes, carrots, celery, corn, mushrooms, onions, and bell peppers.

[0008] Although controlled atmosphere/modified atmosphere storage of produce has been successful, considerable experimentation with controlled atmosphere/modified atmosphere storage of cut flowers and potted plants has led many in the floral industry to conclude that widespread use of these techniques in the floral industry is unfeasible. The range of optimal concentrations of O_2 and CO_2 are very narrow for most cultivars, and any imprecision results in deterioration of cut flowers and potted plants, as well as decreased vase life and increased flower senescence. Also, the optimal concentrations of O_2 and CO_2 differ not only for various species but even for various cultivars and these differences can be quite large. In addition, when considering potted plants, the optimal O_2 and CO_2 concentrations required for one part of a plant may differ from the concentrations required for another part of the plant.

[0009] Transport of flowers and potted plants maintained in controlled/modified atmosphere storage also presents several problems, including handling flowers differently in the same cold chamber as well as the removal of certain flowers from the chamber for delivery while maintaining the modified environment surrounding the remaining flowers. Most trailers make multiple stops as wholesalers prefer to receive small quantities several times a week. In addition, potted plants are more sensitive to ethylene which causes them to deteriorate. Ethylene is produced by flowers in small amounts. Cold

storage at precise temperatures is also required in addition to a controlled atmosphere/modified atmosphere. Typically, boxes and pallet bags restrict air flow thereby resulting in an inefficient and heterogeneous cooling of the flowers. Such unstable or imprecise temperatures also have a deleterious effect on the flowers - i.e. the same deleterious effect as imprecise O_2 and CO_2 concentrations. Because of the high cost and difficulties associated with implementing controlled and/or modified atmosphere storage of flowers, controlled and/or modified atmosphere storage has been traditionally considered economically unfeasible by the floral industry.

[0010] Therefore, economically feasible methods of packaging floral groupings, including cut flowers and potted plants, in atmospheres which will increase the life of the floral grouping over that seen by storage in air are being sought. It is to such methods for packaging a floral grouping in a modified atmosphere that the present invention is directed.

SUMMARY OF THE INVENTION

[0011] According to the present invention, methods for packaging floral groupings in a self cooled modified atmosphere are provided which avoid the disadvantages and defects in the prior art, making the methods economically feasible. Broadly, methods are provided for packaging floral groupings in modified atmosphere or self cooled modified atmosphere at or near the site or

harvest. The package will desirably be of a size and appearance which can be displayed by a retail florist so that the packages will not be opened until the floral groupings are ready for sale, which allows for less handling of the floral groupings at wholesale and distribution points and allows for the bypassing of these points for direct delivery to retail outlets. The package used can be altered to provide a decorative appearance, or may be designed for utility, such as providing price, UPC, car handling tags, or permanent holding material for the floral groupings. By packaging floral groupings singularly or in small groups, different modified atmospheres with specific O_2 and CO_2 concentrations can be used, and more efficient cooling of the floral grouping will therefore be observed. Such modified atmospheres allow for less handling of the floral groupings at wholesale and distribution points and allows for the bypassing of these points for direct delivery to retail outlets, making the modified atmosphere/self cooled modified atmosphere storage system commercially successful and economically feasible.

[0012] The package is constructed of a material which has modified atmosphere characteristics such that the material is permeable to certain gases while impermeable to others. The package includes an open first end and a bonding material present on a portion thereof. The self cooling modified atmosphere package includes a plurality of chambers for selectively isolating and combining at least two chemicals which, when combined, produce an

endothermic reaction thereby providing the self cooling feature of the self cooled modified atmosphere package. The package may also include fluid impermeable perforations to assist in the removal of the floral grouping from the package. A surface packaging agent, which maintains the appearance of the floral grouping may also be present inside or within or on the package.

[0013] In preparing a floral grouping for shipment utilizing the modified atmosphere/self cooled modified atmosphere package, a floral grouping is disposed within the package. A floral grouping maintenance agent capable of maintaining the appearance of the floral grouping may also be disposed within, inside, or on the package. Indeed, maintenance agent may be associated partially or wholly with the floral grouping before sealing the modified atmosphere/self cooled modified atmosphere package (either wholly or partially) about the floral grouping.

[0014] A modified atmosphere is then injected into the package, and the first end of the package which may be partially open is sealed to provide a modified atmosphere package for a floral grouping. The modified atmosphere generally contains O_2 and CO_2 concentrations which differ from those of air.

[0015] One object of the present invention is to provide methods for producing a self cooled modified atmosphere for storage of floral groupings.

[0016] Other objects, features and advantages of the present invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a perspective view illustrating a modified atmosphere package disposed about a floral grouping in accordance with the present invention.

[0018] FIG. 2 is a perspective view illustrating a sheet of material with one edge upturned from which the modified atmosphere package of FIG. 1 is constructed.

[0019] FIG. 3 is a perspective view illustrating a potted plant disposed in an unsealed modified atmosphere package constructed in accordance with the present invention.

[0020] FIG. 4 is a perspective view illustrating the potted plant encapsulated in the modified atmosphere package of FIG. 3.

[0021] FIG. 5 is a perspective view of an unsealed modified atmosphere package having overlapping bonded folds in a base portion of the modified atmosphere package.

[0022] FIG. 6 is a perspective view of the modified atmosphere package of FIG. 5 partially sealed.

[0023] FIG. 7 is a perspective view illustrating a modified atmosphere package disposed about a cut flower wherein a portion of a stem portion of the cut flower is disposed in a vial containing a floral preservative solution.

[0024] FIG. 8 is a perspective view illustrating a self cooling modified atmosphere package disposed about a floral grouping in accordance with the present invention.

[0025] FIG. 9 is a perspective view of a laminated sheet of material with one edge upturned from which the self cooling modified atmosphere package of FIG. 8 is constructed.

[0026] FIG. 10 is a cross-sectional view of the laminated sheet of material of FIG. 9 taken along line 10-10.

[0027] FIG. 11 is a cross-sectional view of another embodiment of a laminated sheet of material having an internally disposed chamber from which a self cooling modified atmosphere package of the present invention can be constructed.

[0028] FIG. 12 is a cross-sectional view of another embodiment of a laminated sheet of material having an attached internally disposed chamber from which a self cooling modified atmosphere package of the present invention can be constructed.

[0029] FIG. 13 is a cross-sectional view of yet another embodiment of a laminated sheet of material having a plurality of internally disposed chambers

from which a self cooling modified atmosphere package of the present invention can be constructed.

[0030] FIG. 14 is a cross-sectional view of the laminated sheet of material of FIG. 11 depicting the internal chamber in a ruptured condition so as to allow the mixing of a first chemical and a second chemical.

[0031] FIG. 15 is a perspective view illustrating a flower pot disposed in an unsealed self cooling modified atmosphere package constructed in accordance with the present invention.

[0032] FIG. 16 is a perspective view illustrating the flower pot encapsulated in the self cooling modified atmosphere package of FIG. 15.

DETAILED DESCRIPTION OF THE INVENTION

[0033] Before explaining the inventive concept in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of the components set forth in the following description (e.g., text, examples, data, and/or tables) or illustrated or shown in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for purpose of description and should not be regarded as limiting, and one of ordinary skill in the art, given the

present specification, would be capable of making and using the presently claimed and disclosed invention in a broad and non-limiting manner.

[0034] DESCRIPTION OF FIGS. 1-2

[0035] Referring now to the drawings, shown in FIG. 1 and designated therein by the general reference numeral 10 is a modified atmosphere package for a floral grouping 12 constructed in accordance with the present invention. The modified atmosphere package 10 has an open first end 14, a closed second end 16, and a sidewall 18. The closed second end 16 and the sidewall 18 of the modified atmosphere package 10 cooperate to define a floral grouping retaining space 20 which openly communicates with the open first end 14 of the modified atmosphere package 10.

[0036] The modified atmosphere package 10 is constructed of a sheet of material 30, which is shown in FIG. 2. The sheet of material 30 has an inner surface 32, an outer surface 34, a periphery 35, and modified atmosphere characteristics 39 such that the sheet of material 30 is permeable to certain gases while being impermeable to other gases. The sheet of material 30 from which the modified atmosphere package 10 is constructed is provided with a bonding material 36 disposed upon the sheet of material 30 for reasons which will be further defined in detail hereinafter. Also, the sheet of material 30 may have fluid impermeable perforations 38 present on a portion thereof.

[0037] The thickness of the sheet of material 30 can vary widely. Generally, however, the sheet of material 30 has a thickness in a range from about 0.1 mil to about 10 mil. Frequently, the sheet of material 30 has a thickness in a range from about 0.2 mil to about 3.5 mil. The sheet of material 30 is constructed from a material which is flexible, semi-rigid, or any combination thereof. The sheet of material 30 may be constructed of a single layer of material or a plurality of layers of the same or different types of materials. When the sheet of material 30 is of a plurality of materials, the layers of material may be connected together or laminated together or connected together by any method described herein or known in the art or the layers of material may be maintained as separate layers. A laminated sheet of material 30 must still retain the previously defined modified atmosphere characteristics.

[0038] The sheet of material 30 may be any shape, and a rectangular shape is shown in FIG. 2 only by way of example. The sheet of material 30, for example only, may be square, rectangular, circular, or any other geometric, non-geometric, asymmetric, or arbitrary or fanciful shape, such as, but not by way of limitation, heart shaped, bear shaped, star shaped, scalloped, etc.

[0039] The sheet of material 30 may be a plastic material constructed from a plastic film having modified atmosphere characteristics, that is, a film which is permeable to some substances and/or gases, but impermeable to others.

The sheet of material 30 will be substantially impermeable to water vapor, microbial contaminants, and liquid. In this way, the modified atmosphere package 10 is capable of keeping the moisture content constant throughout the storage period. The sheet of material 30 may have varying permeabilities to oxygen and carbon dioxide. Partial permeability counteracts the effects of respiration by the floral grouping 12; that is, respiration of the floral grouping 12 maintained in a package which is impermeable to oxygen or carbon dioxide will result in large accumulations of carbon dioxide and depletion of oxygen, both of which can have adverse effects on the floral grouping 12. Therefore, the modified atmosphere package 10 constructed from the sheet of material 30 will have partial permeabilities to oxygen and carbon dioxide, thereby containing the oxygen and carbon dioxide concentrations of the modified atmosphere injected into the modified atmosphere package 10 while controlling the accumulation of carbon dioxide and the depletion of oxygen resulting from respiration of the floral grouping 12.

[0040] Controlled or modified atmosphere film and methods of making said films are known in the art. Such a plastic film is available from Hercules, Incorporated, Hercules Plaza, Wilmington, Del. 19894. Other examples of such a modified atmosphere film include, for example, but not by way of limitation, Polyethylene-D, SEE-PAK®, FRESH-HOLD®, STAR*PAC®, CRYOVAC®, mylar, cellophane, high density polyethylene, low density polyethylene, polypropylene,

polyvinyl chloride, and pliofilm. Different plastic films, or combination of films, may be utilized according to the contents of the package and the modified atmosphere desired within such packages, as described in detail hereinbelow, as well as the oxygen and carbon dioxide permeabilities required to maintain the modified atmosphere. The permeabilities of several films are given hereinafter for example only, and not by way of limitation: mylar film is relatively impermeable to both oxygen and carbon dioxide gases, having permeabilities of about 80 $cc/m^2/atm/day$ for oxygen and about 218 $cc/m^2/atm/day$ for carbon dioxide at 20°C, 0% relative humidity, and 0.5 mil thickness; low density polypropylene is slightly more permeable, having permeabilities in the range of from about 2,200 to about 3,700 $cc/m^2/atm/day$ for oxygen and from about 3,400 to about 13,000 $cc/m^2/atm/day$ for carbon dioxide at 20°C, 0% relative humidity and a thickness in the range of from about 2.0 mil to about 6.0 mil; and pliofilm being substantially more permeable, having permeabilities of about 28,000 $cc/m^2/atm/day$ for oxygen and about 101,700 $cc/m^2/atm/day$ for carbon dioxide at 20°C, 0% relative humidity, and 1.0 mil thickness.

[0041] It should also be noted that the thickness of the film is inversely proportional to the permeability of the film; for example, but not by way of limitation, low density polypropylene having a thickness of 2.0 mil has permeabilities of about 3,700 $cc/m^2/atm/day$ and about 13,000 $cc/m^2/atm/day$

for oxygen and carbon dioxide, respectively, while low density polypropylene having a thickness of 6.0 mil has permeabilities of about 2,200 cc/m^2/atm/day and about 3,400 cc/m^2/atm/day for oxygen and carbon dioxide, respectively. It will be understood that modified atmosphere packages constructed of sheets of material with differing permeabilities may be employed within the spirit and scope of the invention and the appended claims hereto.

[0042] The bonding material 36 may be disposed substantially upon the entirety of the inner surface 32 of the sheet of material 30. The bonding material 36 may also be disposed upon the inner surface 32 of the sheet of material 30 as a strip of bonding material (as shown in FIG. 2). The strip of the bonding material 36 must also be applied over a substantial portion of the periphery 35 of the inner surface 32 of the sheet of material 30 (shown in FIG. 2) so as to effect an air-tight seal when the open first end 14 of the modified atmosphere package 10 is bondingly connected about the floral grouping 12 (shown in FIG. 1).

[0043] One method for disposing a bonding material, in this case an adhesive, on a sheet of material is described in U.S. Pat. No. 5,111,637, entitled, "Method For Wrapping A Floral Grouping", issued to Weder et al. on May 12, 1992, and which is hereby expressly incorporated herein by reference in its entirety. Another method for disposing a bonding material in order to laminate two sheets of material is described in U.S. Pat. No. 4,297,811,

entitled, "Laminated Printed Foil Flower Pot Wrap With Multicolor Appearance", issued to Weder on Nov. 3, 1981, and which is also hereby expressly incorporated herein by reference in its entirety.

[0044] The term "bonding material" when used herein means an adhesive such as a pressure sensitive adhesive, or a cohesive. Where the bonding material is a cohesive, a similar cohesive material must be placed on the adjacent surface for bondingly contacting and bondingly engaging with the cohesive material. The term "bonding material" also includes materials which are heat sealable and, in this instance, the adjacent portions of the material must be brought into contact and then heat must be applied to effect the seal. The term "bonding material" when used herein also means a lacquer, which may be applied to the sheet of material. In order to effectuate the sealing of the lacquer coated areas, heat, pressure, sound waves, or vibrations, may be applied to effect the sealing of the lacquer.

[0045] It will be understood that although this embodiment includes the use of the bonding material 36 to seal the modified atmosphere package 10, other methods of sealing the open first end 14 of the modified atmosphere package 10 to provide an air-tight seal may be used. Examples of alternative sealing methods include, but not by way of limitation, a band (such as a rubber band, ribbon, stribbon, or string) a barb, a staple, a plug, and a clip.

[0046] It will be appreciated that the sheet of material 30 may consist of designs or decorative patterns which are printed, etched, and/or embossed thereon using inks or other printing materials. Each of the above-named patterns may occur alone or in combination. When two or more patterns are present, the patterns may be in register with one another, out of register with one another, or partially in register and partially out of register with one another. Examples of printed designs other than decorative designs include, for example, but not by way of limitation, UPC information, price information, care and handling information, and company or brand logos. An example of an ink which may be applied to one or more surfaces of the sheet of material 30 is described in U.S. Pat. No. 5,147,706, entitled, "Water Based Ink On Foil And/Or Synthetic Organic Polymer", issued to Kingman on Sep. 15, 1991, and which is hereby expressly incorporated herein by reference in its entirety.

[0047] The sheet of material 30 may have various colorings, coatings, embossings, flocking and/or metallic finishes, or other decorative surface ornamentation applied separately or simultaneously, or may be characterized totally or partially by pearlescent, translucent, transparent, iridescent, or have other similar qualities. Each of the above-named characteristics may occur alone or in combination and may be applied to the inner surface 32 and/or the outer surface 34 of the sheet of material 30. Moreover, each of the inner surface and outer surface 32, 34, respectively, of the sheet of material 30 may

vary in the combination of such characteristics. The sheet of material 30 may be opaque, translucent, clear, tinted, transparent or any combination thereof.

[0048] An additional bonding material may also be used to laminate two sheets of material to form the sheet of material 30 and may also be tinted or colored using a dye, pigment, or ink. In this manner, different coloring effects are provided, and the multiple sheets of material forming the sheet of material 30 may be given a colored appearance by use of a colored bonding material. U.S. Pat. No. 5,147,706, described immediately above, provides one water based ink which may be used to tint one or more sheets of material that form the sheet of material 30 or which may be used to tint the bonding material.

[0049] Referring again to FIG. 2, one or more surface packaging agents 40 may be present on the sheet of material 30. The one or more surface packaging agents 40 maintain the appearance of the floral grouping and the modified atmosphere package until ready for sale by methods such as, but not by way of limitation, preventing freezing, preventing disease, wilting and senescence of flowers, and preventing fogging and moisture buildup on the packaging. The one or more surface packaging agents 40 may be a cryo protectant, disinfectant, a desiccant, an anti-fogging agent, an anti-ethylene agent, a cooling enzyme, and combinations thereof.

[0050] In one embodiment, the one or more surface packaging agents 40 may be a cryo protectant disposed on and/or incorporated within the sheet of

material 300. The term "cyro-protectant" as used herein means any substance used to protect cells or tissues from damage during freezing. Examples of cryo protectants, include, but are not limited to, glycerol, propylene glycol, ethylene glycol, dimethyl sulfoxide (DMSO), sodium chloride, calcium chloride, methyl clofenpate, silver thiosulfate, ala alcohols, and combinations thereof.

[0051] It will also be understood that many cryo protectants are known in the art. It will further be appreciated that the precise combinations and amounts of cryo protectants used is dependent upon the results sought and the items to be packaged. The duration of action of the cryo protectants will depend, in part, upon the cryo protectants used, the concentration of the cryo protectants used, and the exposure of the cryo protectants to atmospheric and/or packaged conditions.

[0052] The sheet of material 30 may have a disinfectant as the one or more surface packaging agents 40 disposed thereon and/or incorporated therein. The term "disinfectant" as used herein means an agent possessing antifungal properties, antibacterial (bacteriostatic or bactericidal) properties, insecticidal properties, and/or antimicrobial properties. Examples of disinfectants include, but not by way of limitation, 8-hydroxyquinoline sulfate, 8-hydroxyquinoline citrate, iprodione, procymidone, vinclozolin, VANGUARD® (Ciba-Geigy), prochloraz, PHYSAN®-20, amphyl, sodium hypochlorite, copper sulfate, silver nitrate, silver thiosulfate, thiobendazole, zinc acetate,

chlorpyrifos, methyl bromide, aluminum sulfate, aluminum nitrate, and combinations thereof.

[0053] It will also be understood that many disinfectants are known in the art. It will further be appreciated that the precise combinations and amounts of disinfectants used is dependent upon the results sought and the items to be packaged. The duration of action of the disinfectant(s) will depend, in part, upon the disinfectant(s) used, the concentration of the disinfectant(s) used, and the exposure of the disinfectant(s) to atmospheric and/or packaged conditions.

[0054] The sheet of material 30 may have a desiccant as the one or more surface packaging agents 40 disposed thereon and/or incorporated therein. Such desiccants include, for example, but not by way of limitation, calcium chloride, and silica gel. It will be understood that a number of desiccants are known to those having ordinary skill in the art, and it will be appreciated that the precise amount of desiccant(s) disposed on or incorporated in the sheet of material 30 is dependent upon the results sought and the items to be packaged therein. The duration of action of the desiccant will depend, in part, upon the desiccant(s) used, the concentration of the desiccant(s) used, and the exposure of the desiccant(s) to atmospheric and/or packaged conditions.

[0055] The sheet of material 30 may have an anti-fogging agent as the one or more surface packaging agents 40 disposed thereon and/or incorporated therein. It will be appreciated that anti-fogging agents are known in the art.

It will further be appreciated that the precise amounts of anti-fogging agents used is dependent upon the results sought and the items to be packaged. The duration of action of the agent(s) will depend, in part, upon the agent(s) used, the concentration of the agent(s) used, and the exposure of the agent(s) to atmospheric and/or packaged conditions.

[0056] The desiccant and anti-fogging agent may be disposed solely upon the sheet of material 30. In one preferred embodiment the desiccant and anti-fogging agent are not disposed in the modified atmosphere package 10 with the floral grouping 12 as a floral grouping maintenance agent (described in detail hereinafter) because contact between the desiccant or anti-fogging agent and the floral grouping 12 may decrease the water concentration of the floral grouping 12, causing the floral grouping 12 to wilt.

[0057] The sheet of material 30 may have an anti-ethylene agent as the one or more surface packaging agents 40 disposed thereon and/or incorporated therein. The most adverse and injurious effects on cut flowers and potted plants are caused by ethylene, which is produced in elevated levels by diseased, injured and senescing flowers and floral groupings. Examples of anti-ethylene agents include agents which remove ethylene from the atmosphere as well as agents which inhibit ethylene production or counteract the effects of ethylene. Anti-ethylene agents which remove ethylene from the atmosphere include, but not by way of limitation, potassium permanganate-containing ethylene

scrubbers and activated brominated charcoal. Potassium permanganate-containing ethylene scrubbers contain potassium permanganate adsorbed on carriers with large porous surfaces, such as, but not by way of limitation, alumina pellets, Celite, expanded glass, perlite, silica gel, and vermiculite. Anti-ethylene agents which inhibit ethylene production or counteract the effects of ethylene include, but not by way of limitation, ethylene oxide, aminoethoxyvinylglycine, sodium thiosulfate, sodium benzoate, carbonyl cyanide, cycloheximide, 1-methylcyclopropene, substituted benzothiadiazole, gibberellins, and cytokinins.

[0058] It will be appreciated that the precise amounts of anti-ethylene agents used is dependent upon the results sought and the items to be packaged. The duration of action of the agent will depend, in part, upon the agent(s) used, the concentration of the agent(s) used, and the exposure of the agent(s) to atmospheric and/or packaged conditions.

[0059] The sheet of material 30 may have a cooling enzyme as the one or more surface packaging agents 40 disposed thereon and/or incorporated therein. It will be appreciated that cooling enzymes, which reduce the ambient temperature, are known in the art. It will further be appreciated that the precise amounts of cooling enzymes used is dependent upon the results sought and the items to be packaged. The duration of action of the enzyme will depend, in part, upon the enzyme(s) used, the concentration of the enzyme(s)

used, and the exposure of the enzyme(s) to atmospheric and/or packaged conditions.

[0060] It should be noted that any combination of cryo-protectant disinfectant, anti fogging agent, anti ethylene agent, and/or cooling enzyme may be the one or more packaging agents 40 disposed upon or incorporated in the sheet of material 30. Furthermore, any of the one or more surface packaging agents 40 may be disposed upon the sheet of material 30 by any method known in the art, including, but not by way of limitation, spraying, brushing, immersing the sheet of material 30 in the one or more surface packaging agents 40, and exposure of the sheet of material 30 to the one or more surface packaging agents containing gas, or mixing and/or incorporating the one or more surface packaging agents 40 in a dye, pigment, ink, lacquer, or any combination thereof, or any other medium, which is then applied to the sheet of material 30. Further, it will be understood that the bonding material 36 and any of the one or more surface packaging agents 40 may be disposed upon or incorporated in any item such as, but not by way of limitation, tape, labels, stickers, decals, and the like, and then applied to the sheet of material 30. It will be appreciated that the entire sheet of material 30 may be treated in the manner described above, or, alternatively, only a portion thereof may be treated. The one or more surface packaging agents 40 may also be

incorporated into the sheet of material 30 before or during formation of the sheet of material 30.

[0061] The one or more surface packaging agents 40 may also be mixed with or incorporated in the bonding material 36, the bonding material 36 then being disposed upon at least a portion of the sheet of material 30. Methods for such mixing and/or incorporation are known in the art, as are methods for disposing bonding material on the sheet of material 30. The one or more surface packaging agents 40 may also be mixed with or incorporated into a lacquer, the lacquer then being disposed upon at least a portion of the sheet of material 30.

[0062] The one or more surface packaging agents 40, as well as the bonding material 36, may alternatively be disposed upon the sheet of material 30 via microcapsules. Suitable microcapsules and methods which may be utilized with the above-referenced one or more surface packaging agents 40 and the bonding material 36 are known in the art.

[0063] Referring again to FIGS. 1 and 2, the sheet of material 30 is gathered around the floral grouping 12 to provide the floral grouping retaining space 20 such that the floral grouping 12 is disposed in the floral grouping retaining space 20 of the modified atmosphere package 10 to thereby provide a partially closed package 41 (i.e. the modified atmosphere package 10 in a partially closed state). The open first end 14 of the modified atmosphere

package 10 is partially sealed via the bonding material 36 disposed on the sheet of material 30 to provide a small opening 42 in the open first end 14 of the modified atmosphere package 10. Through the small opening 42, a modified atmosphere 44 is injected into the floral grouping retaining space 20 of the modified atmosphere package 10. The modified atmosphere 44 contains an oxygen concentration ranging from 0% to about 21% by volume, a carbon dioxide concentration ranging from 0% to about 30% by volume, and the remaining concentration of the modified atmosphere 44 being substantially nitrogen.

[0064] Following injection of the modified atmosphere 44 into the floral grouping retaining space 20 of the modified atmosphere package 10, the small opening 42 in the open first end 14 of the modified atmosphere package 10 is sealed via the bonding material 36 present on the sheet of material 30, thereby sealing both the floral grouping 12 and the modified atmosphere 44 within the modified atmosphere package 10.

[0065] The term "floral grouping" may be used interchangeably herein with the terms "plant" and/or "flower". The term "floral grouping" may also be used interchangeably herein with the terms "botanical item" and/or "propagule". The floral grouping 12 may be cut flowers, a potted plant, a botanical item, or propagules.

[0066] The term "botanical item" when used herein means a natural herbaceous or woody plant, taken singly or in combination. The term "botanical item" also means any portion or portions of natural herbaceous or woody plants including stems, leaves, flowers, blossoms, buds, blooms, cones, or roots, taken singly or in combination, or in groupings of such portions such as a bouquet or floral grouping.

[0067] The term "propagule" when used herein means any structure capable of being propagated or acting as an agent of reproduction including seeds, shoots, stems, runners, tubers, plants, leaves, roots, or spores.

[0068] When the floral grouping 12 is a potted plant, the term "floral grouping" includes not only the potted plant but also a pot or container, as well as growing medium. Several advantages to storing potted plants in modified atmosphere storage include, but not by way of limitation, much longer storage times than cut flowers, survival with no need for watering, and prevention of subjection to potentially harmful environments, such as an environment containing ethylene.

[0069] DESCRIPTION OF FIGS. 3 AND 4

[0070] A modified atmosphere package 50 may be formed from a preformed container 51, such as a flower pot cover which is adapted to receive a floral grouping 12a wherein the floral grouping 12a is a potted plant, and the modified atmosphere package 50 is capable of being sealed to create an air-

tight seal at the top of the flower pot cover, as shown in FIG. 4. The modified atmosphere package 50 has an open first end 52, a closed second end 54, and a sidewall 56. The closed second end 54 and the sidewall 56 cooperate to define a floral grouping retaining space 58 which openly communicates with the open first end 52 of the modified atmosphere package 50. The material from which the modified atmosphere package 50 is constructed (i.e., a flower pot cover) will have modified atmosphere characteristics such that the material is permeable to certain gases while impermeable to other gases. A bonding material 60 is provided on at least a portion of an inner surface 62 of the modified atmosphere package 50 for reasons which are described in detail hereinabove with respect to modified atmosphere package 10. Fluid impermeable perforations 64 may also be provided on a portion of the modified atmosphere package 50 to assist in removal of the floral grouping 12a.

[0071] At least one floral grouping maintenance agent 65 may be disposed in the floral grouping retaining space 58 of the modified atmosphere package 50 having the floral grouping 12a disposed therein, and as shown in particular in FIG. 3. The at least one floral grouping maintenance agent 65 is capable of maintaining the appearance of the floral grouping 12a until ready for sale by methods such as, but not by way of limitation, preventing disease, wilting, and senescence of the floral grouping 12a, controlling relative humidity and carbon dioxide levels, and holding the floral grouping 12a in such a position

as to prevent harmful interactions of individual flowers in the floral grouping 12a with other flowers of the floral grouping 12a or the modified atmosphere package 50. The at least one floral grouping maintenance agent 65 may be a cryo protectant, disinfectant, an anti-ethylene agent, an anti-static agent, a water-containing sponge, a carbon dioxide scrubber, a cooling enzyme, a floral holding material, and combinations thereof.

[0072] The use of a cryo protectant, disinfectant, an anti-ethylene agent, or a cooling enzyme as the at least one floral grouping maintenance agent 65 will be substantially the same as the use of these agents as one or more surface packaging agents 40 as previously described in detail hereinabove, with the exception that the use of the at least one floral grouping maintenance agent 65 as with the one or more surface packaging agents 40 requires disposing the at least one floral grouping maintenance agent 65 on or incorporating the at least one floral grouping maintenance agent 65 into the sheet of material 30, while the use of the at least one floral grouping maintenance agent 65 simply requires disposing the at least one floral grouping maintenance agent 65 in the preformed container 51 of the modified atmosphere package 50 having the floral grouping 12a disposed therein.

[0073] An anti-static agent may be disposed in the preformed container 51 of the modified atmosphere package 50 having the floral grouping 12a disposed therein as the at least one floral grouping maintenance agent 65. It will be

appreciated that anti-static agents, which prevent multiple floral stems from becoming entangled, are known in the art. It will further be appreciated that the precise amounts of anti-static agents used is dependent upon the results sought and the items to be packaged. The duration of action of the agent will depend, in part, upon the agent(s) used, the concentration of the agent(s) used, and the exposure of the agent(s) to atmospheric and/or packaged conditions.

[0074] A water-containing sponge may be disposed in the preformed container 51 of the modified atmosphere package 50 having the floral grouping 12a disposed therein as the at least one floral grouping maintenance agent 65. It will be appreciated that sponges are known in the art. It will further be appreciated that the precise amounts of sponge or water used is dependent upon the results sought and the items to be packaged. The duration of action of the agent will depend, in part, upon the size of sponge used, the amount of water used, and the exposure of the water-containing sponge to atmospheric and/or packaged conditions.

[0075] A carbon dioxide scrubber may be disposed in the preformed container 51 of the modified atmosphere package 50 having the floral grouping 12a disposed therein as the at least one floral grouping maintenance agent 65. It will be appreciated that carbon dioxide scrubbers, which remove excess carbon dioxide from the modified atmosphere 44a, are known in the art.

Examples of carbon dioxide scrubbers include, but not by way of limitation, sodium hydroxide, water, activated charcoal, hydrated lime, a molecular sieve, and combinations thereof. It will further be appreciated that the precise amounts of CO_2 scrubbers used is dependent upon the results sought and the items to be packaged. The duration of action of the CO_2 scrubber will depend, in part, upon the scrubber(s) used, the concentration of the scrubber(s) used, and the exposure of the scrubber(s) to atmospheric and/or packaged conditions. It should be noted that any combination of the one or more surface packaging agents 40 and any combination of the floral grouping maintenance agent 65 can be utilized in constructing the modified atmosphere package 50.

[0076] A floral holding material may be disposed in the preformed container 51 of the modified atmosphere package 50 having the floral grouping 12a disposed therein as the at least one floral grouping maintenance agent 65. It will be appreciated that floral holding materials are known in the art. Examples of floral holding material include, but not by way of limitation, florist's foam, polymeric holders, fiberboard, netting, or sleeves to protect blooms, and tissue paper to protect flowers from condensation. The duration of action of the floral holding material will depend, in part, upon the floral holding material(s) used, the amount of floral holding material(s) used, and the exposure of the floral holding material(s) to atmospheric and/or packaged conditions. Such floral holding materials are disclosed in U.S. Patent

No. 5,647,189 entitled Decorative Assembly for a Floral Grouping which is hereby expressly incorporated by reference in its entirety.

[0077] Referring to FIGS. 3 and 4, after the floral grouping 12a is disposed in the floral grouping retaining space 58 of the modified atmosphere package 50, the open first end 52 of the modified atmosphere package 50 is partially closed via the bonding material 60 present on the inner surface 62 of the preformed container 51 of the modified atmosphere package 50. A modified atmosphere 44a is injected into the floral grouping retaining space 58 of the modified atmosphere package 50 through a small opening 42a in the open first end 52 of the modified atmosphere package 50 which is partially closed and sealed by the bonding material 60. Following injection of the modified atmosphere 44a into the floral grouping retaining space 58 of the modified atmosphere package 50, the small opening 42a in the open first end 52 of the modified atmosphere package 50 is sealed via the bonding material 60 present on the inner surface 62 of the preformed container 51 of the modified atmosphere package 50, thereby sealing both the floral grouping 12a and the modified atmosphere 44a within the floral grouping retaining space 58 of the modified atmosphere package 50, as shown in FIG. 4.

[0078] Referring now to the modified atmosphere 44a, depending upon the particular floral grouping 12a, varying ranges of oxygen, carbon dioxide and nitrogen concentrations may be used in the modified atmosphere 44a. The

modified atmosphere 44a may contain an oxygen concentration ranging from 0% to about 10% by volume and the remaining concentration of the modified atmosphere 44a being substantially all nitrogen. The modified atmosphere 44a may contain an oxygen concentration ranging from about 1% to about 3% by volume, a carbon dioxide concentration ranging from 0% to about 15% by volume, and the remaining concentration of the modified atmosphere 44 being substantially all nitrogen. Also, the modified atmosphere 44 may contain an oxygen concentration of 21% by volume, which is the same as normal air, a carbon dioxide concentration ranging from about 8% to about 30% by volume, and the remaining concentration of the modified atmosphere 44 being substantially all nitrogen.

TABLE I. Desired Oxygen and Carbon Dioxide Concentration Ranges for Modified Atmosphere Storage of Specific Flowers

Floral Grouping	O_2% (By Volume)	CO_2% (By Volume)
carnations	0.5 - 21	4 - 20
roses	0.5 - 21	5 - 30
orchids	1 - 21	0 - 2
tulips	3 - 21	0 - 5
narcissus	0	0.00
daffodils	0 - 3	0
anthurium	2 - 10	0
chrysanthemum	1 - 2	0
mimosa	7 - 8	0

TABLE I. Desired Oxygen and Carb n Dioxide C ncentrati n Ranges for M dified Atmosphere Storage of Specific Fl wers		
gladiolus	1 - 3	5 - 15
snapdragon	1 - 2	0 - 15
lilies	21	10 - 20
ferns	21	15 - 30
freesia	21	8 - 12

[0079] Listed above in Table I are the desired oxygen and carbon dioxide concentration ranges for the modified atmosphere 44 and 44a for packaging specific cut flowers. For example, but not by way of limitation, the desired oxygen and carbon dioxide concentrations required for modified atmosphere storage of carnations and roses can vary greatly between different cultivars and storage conditions, while the desired modified atmosphere 44 and 44a about narcissus will contain substantially all molecular nitrogen. Additionally, the desired modified atmosphere 44 and 44a for storing floral groupings such as lilies, ferns, and freesia will contain the normal atmospheric oxygen concentration (21%) and a carbon dioxide concentration in the range of from about 8% to about 30% by volume.

[0080] It will be understood that other modified atmospheres with differing oxygen and carbon dioxide concentration ranges may be employed in the spirit of the present invention for use as the modified atmosphere 44 and 44a.

[0081] DESCRIPTION OF FIGS. 5 AND 6

[0082] Referring now to FIGS. 5 and 6, a modified atmosphere package 66 is illustrated which includes a sleeve 67 constructed of a sheet of material 68 that is similar to the sheet of material 30 of FIGS. 1 and 2. The sleeve 67 includes an upper end 70, a closed second end 72, a base portion 76, and a sidewall 78. The closed second end 72 and the sidewall 78 cooperate to define a floral grouping retaining space 80 which openly communicates with the upper end 70 of the sleeve 67. Fluid impermeable perforations 82 may be present on a portion of the sleeve 67. The sleeve 67 has a first area of bonding material 83 that is similar to the bonding material 36 (shown in FIGS. 1 and 2), disposed on an inner peripheral surface 84 of an upper portion 86 of the sleeve 67 generally in the vicinity of the upper end 70 of the sleeve 67 for allowing the upper end 70 to be sealed, thereby enclosing the upper portion 86 of the sleeve 67 about a floral grouping 87 disposed in the floral grouping retaining space 80 to thereby provide the modified atmosphere package 66 with an airtight seal (FIG. 6). A second area of bonding material 88 may also be disposed on the sleeve 67 generally in the vicinity of the base portion 76 of the sleeve 67 such that when a pot 90 (which may contain the floral grouping 87) is disposed in the floral grouping retaining space 80 and the sleeve 67 is manually or automatically crimped about an outer peripheral surface 92 of the pot 90 in the vicinity of the second area of bonding material 88, overlapping

folds 93 are formed in the base portion 76 of the sleeve 67 generally in the second area of bonding material 88. The overlapping folds 93 are bondingly connected together by the second area of bonding material 88 such that the overlapping folds 93 add structural integrity to the base portion 76 of the sleeve 67 and cooperate to hold the base portion 76 in the shape of a cover similar in shape as the shape of the outer peripheral surface 92 of the pot 90. The overlapping folds 93 also cause the base portion 76 of the sleeve 67 to engage the outer peripheral surface 92 of the pot 90. The second area of bonding material 88 may be disposed on the sleeve 67 at a position below an upper rim 94 of the pot 90, or the second area of bonding material 88 may be disposed at a position on the base portion 76 of the sleeve 67 above the upper rim 94 of the pot 90 such that overlapping folds 93 crimpingly formed are located in a position generally below or above the upper rim 94 of the pot 90. The upper end 70 of the sleeve 67 is partially sealed via the first area of bonding material 83 to provide an opening 96 (FIG. 6) in the upper end 70 of the sleeve 67. Selected gases are introduced to provide a modified atmosphere 44b that is similar to the modified atmosphere 44a (FIGS. 3 and 4) and to the modified atmosphere 44 (FIGS. 1 and 2). The modified atmosphere 44b is then injected into the floral grouping retaining space 80 of the modified atmosphere package 66 through the opening 96 in the upper end 70 of the sleeve 67. After injection of the modified atmosphere 44b, the opening 96 in the upper end 70 of the

sleeve 67 is sealed shut thereby providing the modified atmosphere package 66.

[0083] DESCRIPTION OF FIG. 7

[0084] Referring now to FIG. 7, a modified atmosphere package 100 is illustrated which includes an open first end 102, a closed lower end 104, and a sidewall 106. The closed lower end 104 and the sidewall 106 of the modified atmosphere package 100 cooperate to define a floral grouping retaining space 108 which openly communicates with the open first end 102 of the modified atmosphere package 100. Fluid impermeable perforations 109 may be present on a portion of the modified atmosphere package 100. A floral grouping 110 such as cut flowers having a stem portion 111 and a bloom portion 112 is disposed in the floral grouping retaining space 108. The stem portion 111 of the floral grouping 110 may be dried prior to being disposed in the floral grouping retaining space 108 of the modified atmosphere package 100, or the stem portion 111 may be stored wet. Dry storage permits a longer storage period for some flower species and space savings in storage rooms. Dry storage is typically used when maximum storage periods are required. Wet storage in water or a floral preservative solution is the most common practice for short storage periods.

[0085] When dry storage is used, the floral grouping 110 is usually wrapped in soft paper or newspaper to absorb any condensed moisture appearing on the floral grouping 110 prior to disposing the floral grouping 110 into the floral grouping retaining space of the modified atmosphere package 100.

[0086] When wet storage is used a vial 114, shown in FIG. 7, may be provided and used. The vial 114 includes an upper end 116, a closed lower end 118, and a sidewall 120. The vial 114 may be constructed of, for example but not by way of limitation, plastic, cellulose based materials or other materials such as glass, rubber, synthetic or natural polymers, and combinations thereof. The closed lower end 118 and the sidewall 120 of the vial 114 cooperate to define a floral stem retaining space 122 openly communicating with the upper end 116 of the vial 114, the floral stem retaining space 122 being adapted to receive at least a portion of the stem portion 111 of the floral grouping 110. The vial 114 may or may not be attached to the closed lower end 104 of the modified atmosphere package 100 via a bonding material 124.

[0087] A floral preservative solution 126 is disposed in the floral stem retaining space 122 of the vial 114 prior to placing the stem portion 111 of the floral grouping 110 into the floral stem retaining space 122 of the vial 114. The floral preservative solution 126 may contain water, a cryo protectant, a

carbohydrate compound or formulation, a disinfectant, a growth regulator, an ethylene inhibitor, an acidifier, a wetting agent, and combinations of all of these materials.

[0088] It will be appreciated that carbohydrate compounds and formulations are known in the art. Examples of carbohydrate compounds and formulations include, but not by way of limitation, sucrose, glucose, fructose, and combinations thereof. It will further be appreciated that the precise amounts of carbohydrate compounds and formulations used is dependent upon the results sought and the items to be packaged.

[0089] The use of a cryo protectant in the floral preservative solution 126 will be substantially the same as the use of a cryo protectant as the one or more surface packaging agents 40 (shown in FIGS. 1 and 2) or the at least one floral grouping maintenance agent 65 (shown in FIGS. 3 and 4) as previously described in detail above.

[0090] The use of a disinfectant in the floral preservative solution 126 will be substantially the same as the use of the disinfectant as the one or more surface packaging agents 40 (shown in FIGS. 1 and 2) or the at least one floral grouping maintenance agent 65 (shown in FIGS. 3 and 4) as previously described in detail above.

[0091] It will be appreciated that growth regulators are known in the art. Examples of growth regulators include, but not by way of limitation, maleic

hydrazide, cycloheximide, daminozide, chlormaquat, sodium azide, absicissic acid, n-dimethylamino succinamic acid, cytokinins, auxins, gibberellins, morphactins, and combinations thereof. It will further be appreciated that the precise amounts of growth regulators used is dependent upon the results sought and the items to be packaged.

[0092] The use of an ethylene inhibitor in the floral preservative solution 126 will be substantially similar to the use of the anti-ethylene agent as the one or more surface packaging agents 40 (shown in FIGS. 1 and 2) or the at least one floral grouping maintenance agent 65 (shown in FIGS. 3 and 4) as previously described in detail above, with the exception that the term "anti-ethylene agent" as used herein includes agents which remove ethylene from the atmosphere as well as agents which inhibit ethylene production or counteract the effects of ethylene, while the term "ethylene inhibitor" as used herein only includes agents which inhibit ethylene production or counteract the effects of ethylene.

[0093] It will be appreciated that acidifiers are known in the art. Examples of acidifiers include, but not by way of limitation, citric acid, isoascorbic acid, tartaric acid, aluminum sulfate, and combinations thereof. It will further be appreciated that the precise amounts of acidifiers used is dependent upon the results sought and the items to be packaged.

[0094] It will be appreciated that wetting agents are known in the art. Examples of wetting agents include, but not by way of limitation, sodium hypochlorite, TWEEN®-20 and combinations thereof. The precise amount of wetting agent(s) used is dependent upon the results sought and the items to be packaged.

[0095] Cut flowers, whether stored wet or dry, may be treated by a grower prior to storage. Treatment methods include, but not by way of limitation, spraying or dipping in cryo protectants, disinfectants, pulsing with a floral preservative solution containing carbohydrates, cryo protectants, disinfectants, and/or anti-ethylene agents, rapid precooling, and brief exposure to a modified/controlled atmosphere having a substantially high carbon dioxide concentration (over 30%). Typically, the agents used in pretreatment, namely, the disinfectant, the components of the floral preservative solution, and the carbon dioxide concentration of the modified/controlled atmosphere, are much higher than those used in packaging for prolonged storage, i.e., the one or more surface packaging agents 40, the at least one floral grouping maintenance agent 65, the modified atmosphere 44, 44a, and 44b, and the floral preservative solution 126. Prolonged exposure to the pretreatment conditions will be very injurious to the floral grouping 110, but brief exposure, from 1 to 24 hours by growers prior to packaging and transportation will extend shelf life and thus appearance, and assist in subsequent bud opening of certain flowers

such as, but not by way of limitation, carnations, roses, chrysanthemum, and gladiolus.

[0096] It will be understood that the one or more surface packaging agents 40, the at least one floral grouping maintenance agent 65, and the vial 114 containing the floral preservation solution 126 may be employed in any embodiment of the modified atmosphere package (i.e., the modified atmosphere package 10, 50, 66, and 100) as described herein, and are not limited to use with the specific modified atmosphere package 10, 50, or 66 with which they are disclosed or illustrated.

[0097] In addition to the use of a cryo protectant as the one or more surface packaging agents 40 or as the at least one floral grouping maintenance agent 65, or in the floral preservation solution 126, the floral grouping 12, 12a, 87, and 110 may also be exposed to a cryo protectant prior to disposal or sealing in the modified atmosphere package 10, 50, 66, and 100 by any method known in the art. For example, a cryo protectant may be sprayed on the floral grouping 12, 12a, 87, and 110, or the stem portion 111 of the floral grouping 110 may be soaked in a cryo protectant, or the floral grouping 12, 12a, 87, and 110 may be watered with a solution containing a cryo protectant.

[0098] For the sake of brevity, the modified atmosphere storage conditions described hereinafter will only refer to the modified atmosphere package 10 and the floral grouping 12 and the modified atmosphere 44 contained therein.

However, it should be understood that these conditions will also be observed for the previously described modified atmosphere packages 50, 66, and 100 as well as self cooling modified atmosphere packages 130 and 161 described in detail hereinafter. The modified atmosphere package 10 and thus the floral grouping 12 disposed in the floral grouping retaining space 20 therein will be maintained at a temperature in the range of from about 32 to about 60 degrees Fahrenheit.

[0099] During modified atmosphere storage in which air exchange is restricted, the floral grouping 12 will develop an atmosphere containing reduced oxygen and increased carbon dioxide concentrations due to respiration of the floral grouping 12. Hazards associated with using sealed packaging for storage of flowers include accumulation of ethylene, increase of carbon dioxide concentration, or decrease in oxygen concentration, which can have adverse effects on the appearance of the floral grouping 12. Proper precooling of the floral grouping 12 prior to storage and maintenance of the temperature of the modified atmosphere package 10 about the floral grouping 12 in the desired temperature range will inhibit endogenous ethylene production as well as the rate of respiration; however, in addition to the varying oxygen and carbon dioxide permeabilities of the sheet of material 30 from which the modified atmosphere package 10 is constructed, the one or more surface packaging agents 40 and/or the at least one floral grouping maintenance agent 65,

including anti-ethylene agents and carbon dioxide scrubbers, may either be present on, within, or operably associated with the modified atmosphere package 10 or disposed in the floral grouping retaining space 20 of the modified atmosphere package 10 to prevent these hazards from damaging the floral grouping 12.

[0100] The modified atmosphere package 10 will be of the size, shape, and appearance such that it: (1) can be displayed by a retail florist, (2) will not be opened until ready for sale, and (3) will prevent the handling of the floral grouping 12 at wholesale and distribution points. By packaging floral groupings singularly or in small groups, the modified atmosphere 44 can be manipulated or varied with different compositions, for example, specific O_2 and CO_2 concentrations can be used for different types of flowers and/or floral groupings. This will allow for less handling of the floral groupings at wholesale and distribution points and would even allow bypassing of these points for direct delivery to retail outlets, making the modified atmosphere package to more economically feasible and this more successful in the marketplace.

[0101] Upon sale of the floral grouping 12 that is maintained in the modified atmosphere package 10 to the retail outlet or the consumer, the modified atmosphere package 10 is torn along the fluid impermeable perforations 38 to open the modified atmosphere package 10 and remove the floral grouping 12 from the modified atmosphere package 10.

[0102] The relative humidity of the modified atmosphere package 10 must be high to prevent transpiration by the floral grouping 12. Increased transpiration results in loss of water by cells of the floral grouping 12, which results in petal wilting of the flowers, and the rate of transpiration is inversely proportional to the relative humidity of the air. The relative humidity of the modified atmosphere package 10 containing cut flowers should be about 90% to about 98%. The relative humidity of the modified atmosphere package 10 containing potted plants should be about 80% to about 90%.

[0103] Maintaining a high relative humidity in the modified atmosphere package 10 is fairly easy, since the atmosphere surrounding the flowers quickly becomes saturated. However, too high a relative humidity causes water condensation on the flowers and the modified atmosphere package 10, and interactions between the condensed water and the floral grouping 12 will result in petal damage and spreading of diseases, such as, but not by way of limitation, *Botrytis* gray mold. The one or more surface packaging agents 40 and the at least one floral grouping maintenance agent 65 are included in the modified atmosphere package 10 in order to prevent the floral grouping 12 from contacting condensed water.

[0104] DESCRIPTION OF FIGS. 8-16

[0105] One of the most important factors in floral preservation is maintaining flowers at approximately 32° Fahrenheit. Referring to FIG. 8, designated therein by the general reference numeral 130, is a self cooling modified atmosphere package for a floral grouping 131 constructed in accordance with the present invention. The self cooling modified atmosphere package 130 has an open first end 132, a closed second end 134, and a sidewall 136. The closed second end 134 and the sidewall 136 cooperate to define a floral group retaining space 138 which openly communicates with the open first end 132 of the self cooling modified atmosphere package 130.

[0106] The self cooling modified atmosphere package 130 is formed from a laminated sheet of material 140, shown in FIGS. 9 and 10. The laminated sheet of material 140 is characterized as having an inner surface 142, an outer surface 144, an outer periphery 146, and modified atmosphere characteristics such that the laminated sheet of material 140 is permeable to certain gases while remaining impermeable to other gases. The laminated sheet of material 140 from which the self cooling modified atmosphere package 130 is constructed is provided with a bonding material 148 disposed upon the laminated sheet of material 140 for reasons which will be described in detail hereinafter.

[0107] The laminated sheet of material 140 is constructed of a first sheet of material 152, a second sheet of material 153, and a third sheet of material 154. The first and second sheets of material 152, 153, respectively, are similar to the sheet of material 30 described herein above. The third sheet of material 154 is formed of a material that may be penetrated, torn, punctured, or ruptured without disrupting or disturbing the first and second sheets of material 152, 153, respectively. The first, second, and third sheets of material 152, 153, 154, respectively, are sealed together to form the laminated sheet of material 140 in such a manner so as to provide a first chamber 155 located between the first and second sheets of material 152, 153, respectively, and a second chamber 156 located between the second and third sheets of material 153, 154, respectively. That is, the outer periphery 146 of the first, second, and third sheets of material 152, 153, 154, respectively, are the only portions of the first, second, and third sheets of material 152, 153, 154, respectively, that are sealed or attached together to form the laminated sheet of material 140, and by sealing in such a manner, the first and second chambers 155, 156, respectively, are provided in between each of the first, second, and third sheets of material 152, 153, 154, respectively. The bonding material 148 is preferably disposed over a portion of the inner surface 142 of the laminated sheet of material 140 near the outer periphery 146. The bonding material 148 must be applied over a substantial part of the outer periphery 146

of the laminated sheet of material 140 so as to effect an air-tight seal upon bondingly connecting the open first end 132 of the self cooling modified atmosphere package 130.

[0108] A first chemical 157 is disposed in the first chamber 155. A second chemical 158 is disposed in the second chamber 156. The first and second sheets of material 152, 153, respectively, are substantially impermeable to the first and second chemicals 157, 158, respectively. When the third sheet of material 154 is not perforated, torn, punctured, or ruptured (i.e., in an intact state), it is also impermeable to the first and second chemicals 157, 158, respectively.

[0109] The thickness of the third sheet of material 154 can vary widely as long as the third sheet of material 154 is capable of being easily ruptured or torn. Generally, however, the third sheet of material 154 is thinner than the first sheet of material 152 or the second sheet of material 153. The third sheet of material 154 may have a thickness in a range from about 0.1 mil to about 10 mil. Frequently, the third sheet of material 154 has a thickness in a range from about 0.2 mil to about 3.5 mil.

[0110] The third sheet of material 154 is constructed of a material and of a design, configuration, and thickness such that the third sheet of material 154 breaks, ruptures, tears, or separates before the first sheet of material 152 or the second sheet of material 153 breaks, ruptures, tears when a force is applied

to the laminated sheet of material 140. The third sheet of material 154 may also include a plurality of separating elements 159. The plurality of separating elements 159 are impermeable to the first chemical 157 and the second chemical 158, when the third sheet of material 154 is intact. For example, the plurality of separating elements 159 can be thin or weakened areas or weakened seals, indentations, or combinations and derivations of the same designed to facilitate and insure that the third sheet of material 154 breaks, ruptures, tears, or separates prior to the first sheet of material 152 or second sheet of material 153 breaking, rupturing, tearing, or separating when the laminated sheet of material 140 is placed under pressure, force, or stress. The first chemical and the second chemical 157, 158, respectively, are isolated from each other until the third sheet of material 154 is selectively ruptured, separated, or torn by an operator thereby allowing the first and second chemicals 157, and 158 to combine.

[0111] The first chemical 157 and the second chemical 158 are any chemicals that, when combined, produce an endothermic reaction. Such chemical combinations are well know in the art. By way of example, but not limitation, the first chemical 157 could be ammonium nitrate, potassium nitrate, or ammonium chloride and the second chemical 158 water, or the first chemical 157 could be ammonium thiocyanate and the second chemical 158 barium hydroxide or the first chemical 157 could be urea and the second

chemical 158 ammonium chloride. The selection, quantity and concentration of the first and second chemicals 157, 158, respectively, is dependent upon, among other things, the amount of cooling effect desired. Preferably, the first and second chemicals 157 and 158 are ammonium nitrate and water. One advantage of the combination of ammonium nitrate and water as the first and second chemicals 157 and 158 is that after the endothermic reaction is exhausted, the laminated sheet of material 140 can be punctured and the resulting solution can be further diluted with water and utilized as a fertilizer. The first and second chemicals 157 and 158 may be artificially colored with coloring agents for a decorative effect in the event the first sheet of material 152 or the second sheet of material 153 or any portion or combination thereof are transparent or translucent. Coloring agents such as food coloring, dyes, and paints are well known in the art and need not be described herein.

[0112] Referring now to FIG. 11, shown therein is another embodiment of the laminated sheet of material 140. A laminated sheet of material 160 is used for forming a self cooling modified atmosphere package 161. The ends of a first sheet of material 162 and a second sheet of material 164 are sealed together, thereby providing a first chamber 166 between the first sheet of material 162 and the second sheet of material 164. A third sheet of material 168 is formed into a bag or sack 170 that is disposed within the first chamber 166. A second chamber 172 is formed in the interior of the bag or sack 170. The bag or

sack 170 may or may not be attached to either of the first and second sheets of material 162, 164, respectively. The previously described first chemical 157 is disposed in the first chamber 166 and the previously described second chemical 158 is disposed in the second chamber 172.

[0113] Referring now to FIG. 12 shown therein is another embodiment of the laminated sheet of material 140. A laminated sheet of material 180 is constructed from a first sheet of material 182 , a second of material sheet 184, and a third sheet of material 186. In this embodiment ends of the third sheet of material 186 are attached to the first sheet of material 182 so as to provide a first chamber 188 formed between the first and second sheets of material 182, 184, respectively. A second chamber 190 is formed between the second sheet of material 184 and the third sheet of material 186. This configuration allows for the first chamber 188 and the second chamber 190 to have different volumes. The different volumes allow for the first chemical 157 and the second chemical 158 to be mixed in any desired ratio by varying the ratio of the volume of the first chamber 188 to the volume of the second chamber 190.

[0114] Referring now to FIG. 13 shown therein is another embodiment of the laminated sheet of material 140. A laminated sheet of material 200 is constructed from a first sheet of material 202, a second sheet of material 204, and a plurality of third sheets of material 206 so as to create a first

chamber 208 and a plurality of second chambers 210. One advantage of having the plurality of second chambers 210 is that the ratio of the first chemical 157 to the second chemical 158 can be varied by varying the total volume of the plurality of second chambers 210 to the volume of the first chamber 208. Another advantage to having the plurality of second chambers 210 is that the rate of combination of the first chemical 157 with the second chemical 158 is controllable by sequentially breaking the plurality of third sheets of material 206. Yet another advantage of having the plurality of second chambers 210 is that more than two different chemicals (isolated initially in the plurality of second chambers 210) can be utilized to produce the desired endothermic reaction.

[0115] Referring now to FIG. 14, in operation, in order to form the laminated sheet of material 160 into the self cooling modified atmosphere package 161, the operator takes the laminated sheet of material 160 and squeezes the laminated sheet of material 160 so as to break the third sheet of material 168. The breaking of the third sheet of material 168 allows the first chemical 157 and the second chemical 158 to mix and produce the desired endothermic reaction thereby providing a cooling effect.

[0116] Referring now to FIGS. 15 and 16, laminated sheet of material 160 is gathered around floral grouping 220 to provide a floral grouping retaining space 222 such that the floral grouping 220 is disposed in the floral grouping

retaining space 222. A first end 224 of the laminated sheet of material 160 is partially sealed via a bonding material 226 disposed on the laminated sheet of material 160 to provide a small opening 228 in the first end 224 of the self cooling modified atmosphere package 161 to thereby provide a partially closed package 229. Through the small opening 228, the previously described modified atmosphere 44 is injected into the floral grouping retaining space 222 of the partially closed package 229. The modified atmosphere 44, as previously stated, contains an oxygen concentration ranging from 0% to about 21% by volume, a carbon dioxide concentration ranging from 0% to about 30% by volume, and the remaining concentration of the modified atmosphere 44 being substantially all nitrogen.

[0117] Following injection of the modified atmosphere 44 into the floral grouping retaining space 222, the small opening 228 in the first end 224 of the partially closed package 161 is sealed via the bonding material 226 thereby sealing in both the floral grouping 220 and the modified atmosphere and thereby providing the self cooling modified atmosphere package 161.

[0118] From the above description, it is clear that the present invention is well adapted to carry out the objects and to attain the advantages mentioned herein as well as those inherent in the invention. While presently preferred embodiments of the invention have been described for purposes of this disclosure, it will be understood that numerous changes may be made which

will readily suggest themselves to those skilled in the art and which are accomplished within the spirit of the invention disclosed and as defined in the appended claims.